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ABSTRACT

Within an inservice training program there is a functional interdependent relationship among problems, causes, and solutions. During a sequence of eight steps to ascertain program impact, a "continuity matrix", a management technique that assists in dealing with the problem/solution paradox is created. A successful training program must: (1) aim at specific levels of teaching: (2) state expected performance objectives: (3) establish procedures for determining discrepancy by comparing expected performance with actual performance: (4) compose problem statements using the unacceptable discrepancies: (5) identify functional links between the causes of problems and their solutions using a continuity matrix: (6) analyze problem statements: (7) define the causes of the problems: and (8) design strategies to reduce or eliminate the causes of problems. It must be remembered that solutions inevitably have side effects which may affect the entire structure. A complete continuity matrix shows program activities, solution approaches, problem statements, and causes. (FG)

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DISCREPANCY ANALYSIS AND CONTINUITY MATRIX: TOOLS FOR MEASURING THE IMPACT OF INSERVICE TRAINING

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Introduction

Discrepancy as used in this seminar means the measured difference between actual and expected performance. A process for determining the existence of a discrepancy includes four steps:

1. Determine the level or levels that are to be included (level and subsystem are used interchangeably).
2. Specify the expected performance of the level being measured.
3. Establish procedures for determining a discrepancy.
4. Compose statements that describe a measured discrepancy.

The outcome resulting from this process is a problem statement.

Most needs assessments and evaluation designs employ a similar process. For example, first a need is identified and then a solution approach is developed. However, often the prescribed solution approach fails to impact the discrepancy. Matching the most appropriate solution to a problem is critical to providing effective and efficient inservice. A systematic methodology for increasing the possibility of matching a problem with appropriate inservice includes four logically related steps:

5. Analysis of the problem statement.
6. Delineation of probable cause or causes.
7. Possible solution approaches.
8. Inservice program activity.

These steps should be performed in sequence.

The initial discrepancy measured before any program activity becomes the pre-test. After completion of prescribed program

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activity the discrepancy is measured again and becomes the post-test. By comparing pre- and post-test measures impact can be determined.

There are two concerns that can distort the degree of impact. First is determining the appropriate time to collect post-test data. Some inservice will require years before any measureable impact occurs. Other inservice will have immediate impact with increasing or decreasing magnitude over various time periods. There is no prescription for determining the ideal elapsed time. It is important to study what implications elapsed time may have on final program activity impact.

The second concern is one that continually plagues the measuring of inservice. Too often inservice is carried out to teach a specific item and then measures are taken to determine impact when in fact the item was never implemented by the trainees. That is measures were taken regarding a non-event. For example, Teacher Effectiveness is a communication model that requires certain defined behaviors by teachers. Training associated with Teacher Effectiveness requires thirty hours. After training, teachers are expected to return to their classrooms and use the model to resolve problems of communication. Suppose the range of use of the model went from 10 percent to 60 percent by the teachers trained. Post measures would reveal no difference between pre and post measures. Was Teacher Effectiveness a poor choice for inservice training? Was the inservice director doing a poor job of training?

Appropriate elapsed time requires judgments in terms of program activity objectives and content. Thus, there is really no formula

or procedure that can be used as a guideline for determining when to collect post measures. Measuring a non-event, however, can be prevented. The extent or degree of implementation of received training is measureable. For example, Teacher Effectiveness requires the use of a precisely defined set of behaviors. The behaviors are to be used in response to specific communication problems. Observation and monitoring instruments based on Flander's Interaction Matrix can be designed to measure the extent specific training skills are being used. By using a matrix measured impact can be qualified in terms of extent of use.

The process to ascertain impact includes eight steps. Our purpose now will be to define, describe and provide examples of each step.

Steps

Levels. In the past processes to determine problems usually focused on the individual student as the basic unit of analysis. Consequently, standardized tests gained wide use as a means to collect data upon which problem statements could be formulated. This approach left hanging the question of effectiveness in terms of interrelationships between goals and objectives and resource allocation at the various levels of the educational system. Today we recognize that the operation of schools represents a complex system composed of many levels. Different data may be required at different levels, with different criteria required to assess each level. For example, a

superintendent is interested in trends concerning taxation, legislation, court decisions, etc., while a board of education is usually concerned with community attitudes toward education and the cost-effectiveness ratio of the system's operation.

As a system education includes specialized structures to achieve specified goals or outputs. Each structure represents a level commonly referred to as a subsystem. Like the total system, each subsystem includes a sequence of input, process and output operating within a span of time resulting in a change of state occurring between input and output. In terms of the system, subsystems maintain a degree of autonomy while at the same time have an independent effect upon system output. For example, teachers who vary from a prescribed curriculum will effect student performance on a test of the prescribed curriculum. Administrators who fail to provide resources at an expected date will effect a teacher's performance. Varying from the prescribed curriculum and failing to provide resources will effect total system output. Thus, in selecting levels the first criterion is to identify those levels that have the most measureable effect on expected output.

A second criterion is to assure that expected performance by a specialized structure exhibits program continuity among subsystems. For example, an objective for the total system could be that all students will score above the fiftieth percentile on a fourth-grade standardized achievement test in mathematics by the end of the fourth grade. The classroom level of performance, representing a subsystem, could have as an objective: Given ten long division

problems, each student will solve at least seven. Continuity exists between the two objectives because students must be able to solve division problems before they can pass a standardized achievement test in mathematics.

Assuming that a hierarchial relationship should exist within the levels of education, objectives ascribed to by the total school system will necessarily be more global than objectives prescribed for a classroom level of operation. The global objectives of a school system will, for example, subsume the more precise objectives of a classroom program making it possible to trace the continuity in terms of function between global objectives and the objectives of various levels of the total system.

To illustrate the procedures the following levels have been selected on the basis of the described criteria:

1. System wide structures: finance, administration, school board.
2. Program: middle school, kindergarten, BSCC.
3. Curriculum: expected outcomes.

The three levels selected, when varied, result in a measureable impact on expected performance and continuity exists among the levels. For example, a teacher uses a certain teaching strategy to achieve expected outcomes in a specific program such as individualized instruction with support from system wide structures, i.e., staff, facilities, salaries, etc. Vary any one of the levels and expected performance will also vary. The base line from which discrepancies can be determined is provided by specifying the expected performance of each level.

Expected Performance

Specifying the expected performance for a level requires writing what goal, objective or output is to be achieved. To complete the prescribed task, what is to be achieved must be written as a precise objective which should include the conditions, primarily time; criteria, the expected level of performance; and a description of what is to be achieved. The objective, regardless of format, should precisely communicate the planned performance of a level in a particular time frame. These objectives will provide the base line from which comparisons and measures can be made to determine those discrepancies that should be reduced to problem statements.

Establish Procedures for Determining Discrepancy

Expected performance translated into specific performance objectives with criteria provides the base line from which measures of actual performance may be computed. By comparing expected performance with actual performance a degree of discrepancy can be ascertained. Using that measured degree problem statements can be formulated. Initiating the process requires the completion of the following tasks:

1. Compose Test Items
2. Sort Test Items into Test Instruments
3. Develop Master Test Schedule
4. Determine Acceptable Discrepancy

Compose Test Items. Measuring requires the composition of test items to provide information necessary to determine the relationship between expected performance and actual performance. At least one test item should be written for each objective specified for the

system wide structure, program and curriculum levels.

For the curriculum level a pre- and post-test item should be written for each objective. Determining entry characteristics of students before they receive the contrived treatment of a program is essential. Even precise pre- and post-test measures, however, may not be able to identify that success and/or failure which may be due to maturation and environment. With comparative information, however, the chances of an improved measure are better.

Sort Test Items. For control and manageability, all test items should be assigned a code number to aid in identification and retrieval. The original objective for which the test item was written should carry the same code. Any numbering system could be used; for example, accrediting agency and course numbering systems can be adapted as code numbers. However, it is suggested that a system be compatible with computerized data processing. After codes are assigned categories carrying a cue digit can be established for sorting test items into instruments. For example, the digit "8" could indicate a category for all finance-related test items. As a result of sorting test items each level or component of each level will have a test instrument for completing a discrepancy analysis.

Develop Master Test Schedule. Since every level functions with precise time constraints, a primary consideration is when to test. For example, staffing should be complete before school opens; under ideal conditions, it should be complete in the spring of the previous year. Public relations occurs year round. The achievement

of objectives assigned various programs should be completed after the proposed sequence of instructional events has taken place. Resolving the problem of when to test requires developing a Master Test Schedule.

Included in your materials is a sample Master Test Schedule with a limited number of entries. The schedule has four parts: first, three levels (system wide structures, curriculum, program); second, categories and instrument codes; third, time constraints; and fourth, personnel responsible to complete the actual measurement.

Those responsible for testing must be provided adequate training in using test instruments. Equally important, prudence must be used in assigning staff members to complete the Master Test Schedule. At the system level, an outside agency should be employed to complete the measurement. For the program level, staff assigned at a central level to coordinate traditional testing programs should administer program level testing. Measuring subsystems requires staff from outside a particular school but employees of the school system. Classroom teachers should be responsible for the pre and post measures at the curriculum level.

Determine Acceptable Discrepancy. Analysis involves comparing planned performance with actual performance. The discrepancy is revealed by noting the variance between the two. The critical question is not whether there is a discrepancy but rather the acceptable degree of discrepancy. In terms of specific objectives the answer can be determined by the extent to which the prescribed

criteria have been achieved. However, this becomes difficult when considering a number of objectives. There is no pat answer since the answer is a judgment made by a school system in terms of philosophy, resources, staff, community attitude and history. However, the acceptable level should be a decision made in terms of the total mix of the system, program and curriculum objectives in a specific time continuum. For example, a fifty percent achievement of stated objectives for a new mathematics program may be acceptable the first year but not the second. If a reduction in teacher/pupil ratio was a system objective but funds were inadequate or unavailable, a judgment would be necessary. Local philosophy and conditions must be considered and are sometimes more important in determining acceptable discrepancy than rigidly prescribed statistical and quantitative procedures.

Assuming continuity and impact of performance of any one level upon all levels, all levels must be analyzed to determine the acceptable discrepancy of any one level. If a program does not function as prescribed, student achievement will be influenced. Inadequate implementation of system wide structures often results in ineffective operation of programs. Curriculum objectives prescribing acehivement beyond program capacity will always result in unacceptable discrepancies. What must be kept in view is that varying one level of expected performance will impact output of all levels. Thus, degree of impact determines if the identified discrepancy is acceptable or if it requires translation into a problem statement.

Composing Problem Statements

After expected performance is compared with actual performance items indicating an unacceptable discrepancy are identified. Having identified unacceptable discrepancies a problem statement must be written. Several examples illustrate the format and style of a problem statement:

> In terms of prescribed curriculum objectives for seventh year mathematics, it was noted that students with high ability were achieving less than the prescribed criteria in graph interpretation.
>
> In School S_3 the program specifications for individualized instruction were not being followed in immediate feedback and pre-testing.
>
> As prescribed in system wide structures of expected performance for the summer it was noted in Schools S_1, S_5 and S_9 that they were not painted or appropriately landscapped before the opening of school.
>
> In Schools S_1 and S_7 the student population is not acquiring acceptable levels of performance in the curriculum areas of English and social studies.

Neither precise analysis of problem cause nor exact problem description is necessary at this point because the problem statement will be rigorously analyzed using the technique of Continuity Matrix Analysis. It is essential, however, for inservice directors to delineate a problem that represents the realities of the system's objective.

A uniform and identifable thinking process for logically arriving at decisions for needed problem solutions, regardless of problem size or type situation, revolves around four steps:

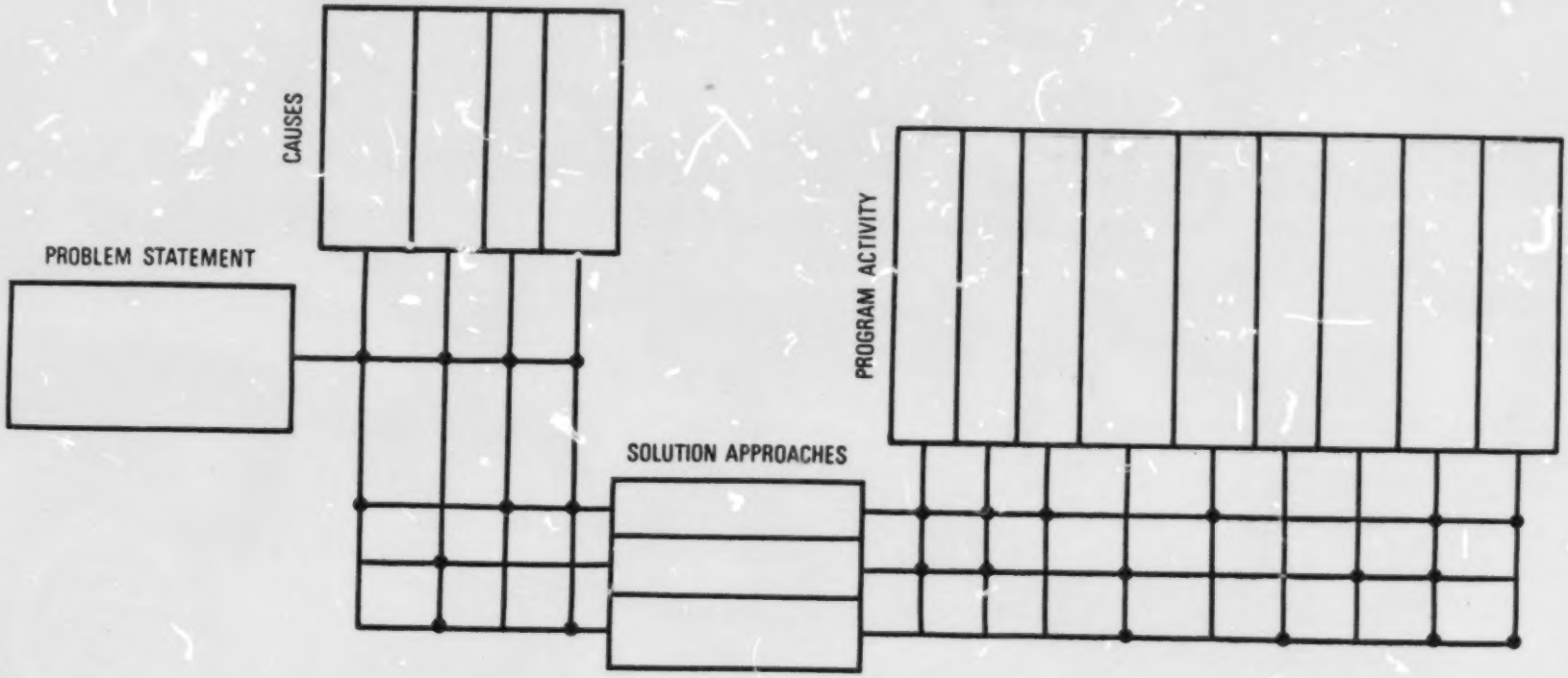
5. Analysis of problem statement.
6. Delineation of probable cause or causes.
7. Possible solution approaches.
8. Inservice program activity.

Since resulting information from the execution of each step provides data upon which succeeding steps are based, these steps should be performed in sequence. This process can be used to think through on-going activities and can serve as a basis for planning inservice.

Continuity Matrix.

Continuity Matrix, a management technique to help inservice directors deal with the problem solution paradox, graphically shows functional linkage among problem analysis, causal definition, solution approaches and program activity. In Figure I, a typical Continuity Matrix, lines drawn from box to box illustrate functional linkage among the various parts. When each box is labeled according to function represented and is connected with lines, the relationship among parts is visually apparent. When a functional linkage exists between problem causes and solution approaches, a program has continuity, i.e., solution activities are based on problem causes.

Although visually illustrating functional relationships among program variables enables inservice directors to improve the possibility of correctly matching a solution to a problem, it does not guarantee correct match. Adding the ability to construct a Continuity Matrix to other techniques presented will improve the capability of inservice directors to analyze, direct, control and coordinate complex training programs.



TYPICAL STRUCTURE OF A CONTINUITY MATRIX

Figure I

Analysis of Problem Statement. In defining the problem statement, care must be exercised to prevent the possibility that only symptoms of a problem have been listed. To avoid this possibility problem analysis is necessary once the problem statement has been written.

To demonstrate problem analysis let us examine a hypothetical problem that might have been identified from a typical needs assessment. In our example, data derived during a needs assessment revealed that students were not acquiring necessary concepts in English and social studies. The problem statement might read "In Schools S_1 and S_2 the student population is not acquiring concepts in English and social studies at an acceptable level." From this problem statement the analyzer must

1. Isolate symptoms of indicators or problem area and document.
2. Formulate a standard against which a gap-condition can be measured.
3. Collect data to determine true state of problematic situation.
4. Formulate a concise statement describing the problem, reflecting the variance between the existing state and the desired standard.

One should not move immediately from problem definition to solution identification because if problem causes are not properly understood, solution approaches will be hit or miss. Problems themselves cannot be treated directly but rather are impacted through treatment of causes giving rise to problems.

At the conclusion of persistent analysis in our example, the following facts were discovered.

1. Only some students experienced difficulty with the subject content of English and social studies.

2. The degree of difficulty being experienced by students varied among students.
3. Students having difficulty with one subject also experienced difficulty with the other.
4. The testing program revealed a range of scores in Language Arts from three years to twelve years grade placement (a span of nine years in achievement).
5. Although median grade placement was seventh year, first month, analysis revealed that student scores were widely scattered throughout the distribution above and below the median.

Evident from this data is the fact that a wide variation in language ability existed among the students. After observing classroom instruction it was apparent that the complaining teachers' methodologies assumed students possessed the ability to read at grade level. In addition, the courses as taught were primarily "reading" courses.

In practice it is difficult at times to distinguish between symptoms and problem. Most scientific approaches to problem resolution have this weakness. Nothing to date will replace research, logic and common sense in determining when a problem has been identified. A combination of such attributes, in addition to a planned, systematic approach, will usually result in a useable problem statement. The following problem statement was derived from the analysis in our example:

> Selected students experiencing difficulty with the subject content of English and social studies exhibit a low degree of language (reading) ability (three years in achievement) but are required to comprehend (read) at the same level as all students.

Causal Definition. Causal definition defines the substance of the problem. . .those substantitve conditions that act together to create and/or maintain the problem in its recognized magnitude.

Although differentiation between facts or data that substantiate a problem definition and conditions that contribute to the cause is difficult, a test may be applied to differentiate between the two. If a condition is or conditions are eliminated, a significant reduction or elimination of the problem should result. Since a Continuity Matrix facilitates visual linkage between problem and problem causes, the proposed test can be applied by tracing problem causes to problem. The only true test, however, is to measure impact upon problem after the condition is reduced or eliminated.

Causal definition must result in at least one cause being identified for each problem. Problem causes not identified may result in less than maximum activity impact on the problem. Rationale behind the definition of causes should be documented so that future inservice can be directed at refining the assessed causal relationships.

Continuing with our example, an appraisal of teaching materials, teaching methodologies and non-classroom factors indicated that these conditions contributed to the problem cause:

1. Classroom instruction consisted of lectures and reading assignments with one lesson for all students.
2. All students used one textbook designed for the typical grade level student.
3. Teacher-pupil ratio was one teacher for every 35 students.
4. Students with widely varying academic backgrounds are placed in the same classroom.

Listed causes are now placed in appropriate boxes and linked by lines to the problem statement shown in Figure II. A dot represents a positive relationship between two items connected by lines.

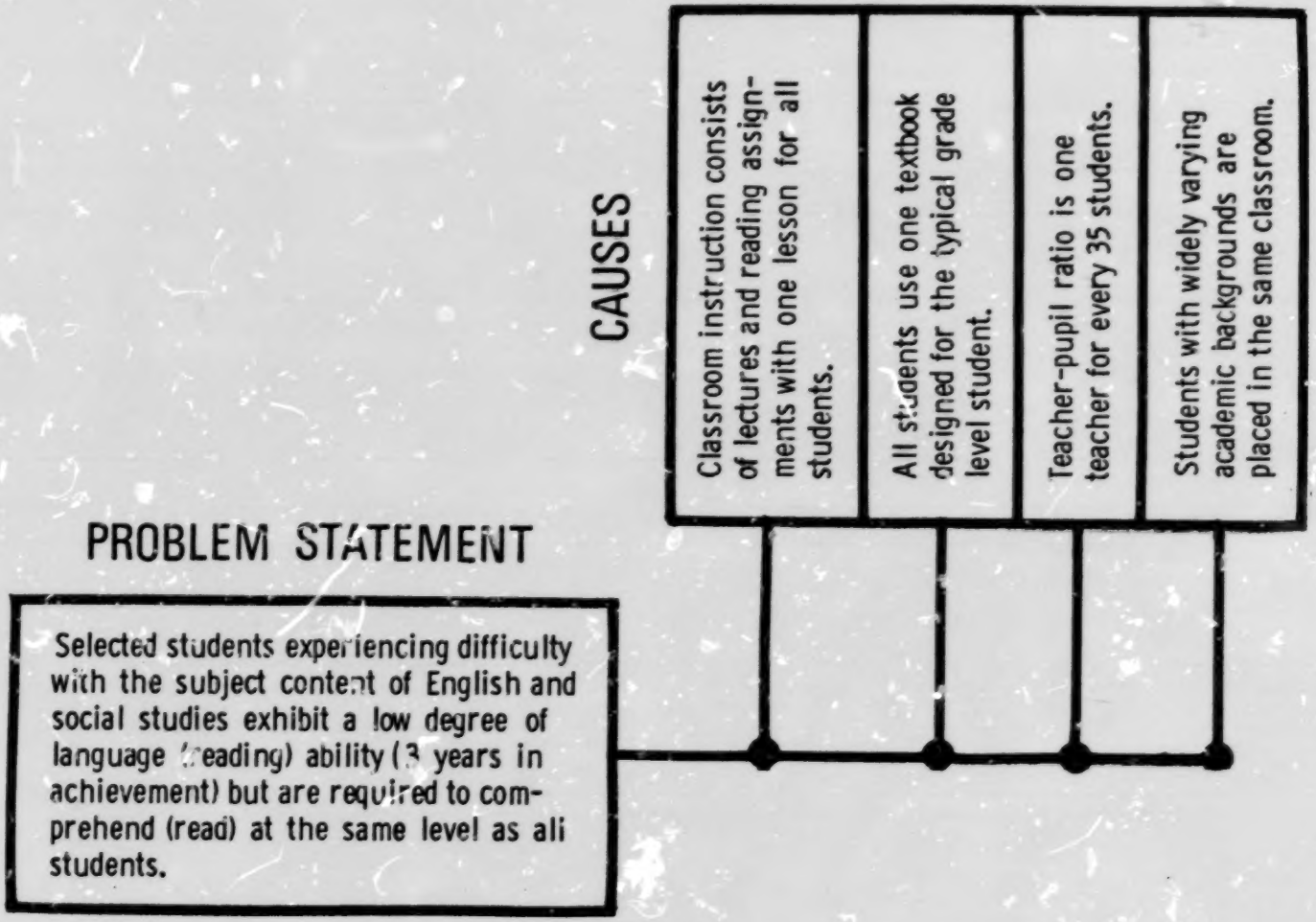

CAUSES
Classroom instruction consists of lectures and reading assignments with one lesson for all students.
All students use one textbook designed for the typical grade level student.
Teacher-pupil ratio is one teacher for every 35 students.
Students with widely varying academic backgrounds are placed in the same classroom.
PROBLEM STATEMENT
Selected students experiencing difficulty with the subject content of English and social studies exhibit a low degree of language (reading) ability (3 years in achievement) but are required to comprehend (read) at the same level as all students.

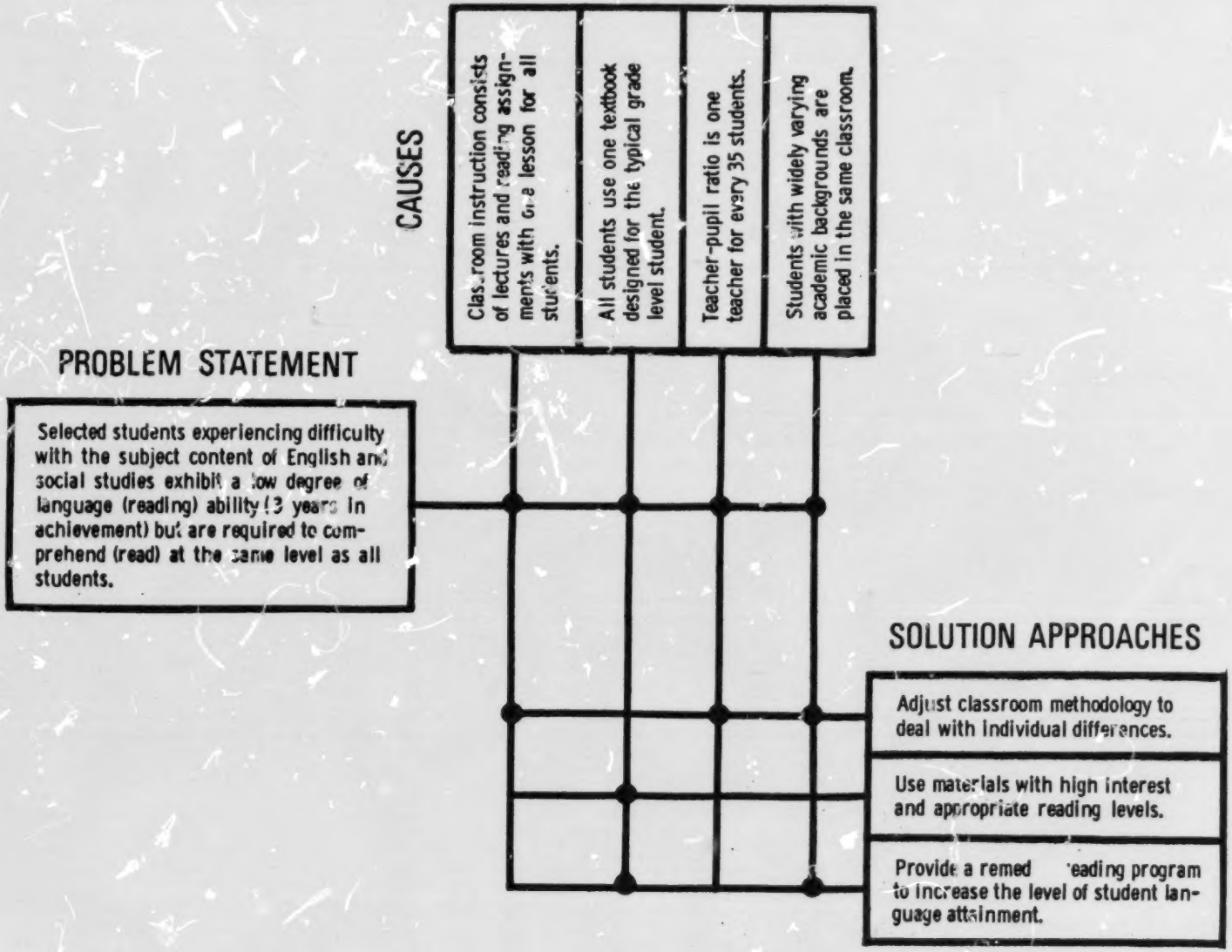
Figure II

Solution Approaches. Designing strategies to reduce or eliminate problem causes requires correctly matching cause with solution. For example, purchasing a remedial reading program to raise the language ability of students would be more effective than purchasing new English and social studies materials that fail to accommodate students' variations in reading achievement. Maximizing solution impact through a combination of factors--schedule alteration to provide time for students to pursue a remedial reading program and the addition of high interest, low reading level English and social studies materials--are vital considerations.

Each solution approach should be placed in a box and linked to the cause being treated. When the solution approach deals with more than one cause a dot is placed where the lines intersect, shown in Figure III. The following three solution approaches can reasonably be expected to treat the defined causes in our example:

1. Adjust classroom methodology to deal with individual differences.
2. Use materials with high interest and appropriate reading levels.
3. Provide a remedial reading program to increase the level of student language attainment.

Inservice Program Activity. The last step is to design inservice activities necessary to implement solution approaches. Somewhere between solution approaches and program activity most program continuity breaks down. Adjusting classroom methodology and introducing low level, high interest reading materials, in our example, may create problems rather than provide a solution. Teachers usually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PROBLEM STATEMENT
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SOLUTION APPROACHES
Adjust classroom methodology to deal with individual differences.
Use materials with high interest and appropriate reading levels.
Provide a remedial reading program to increase the level of student language attainment.

Figure III

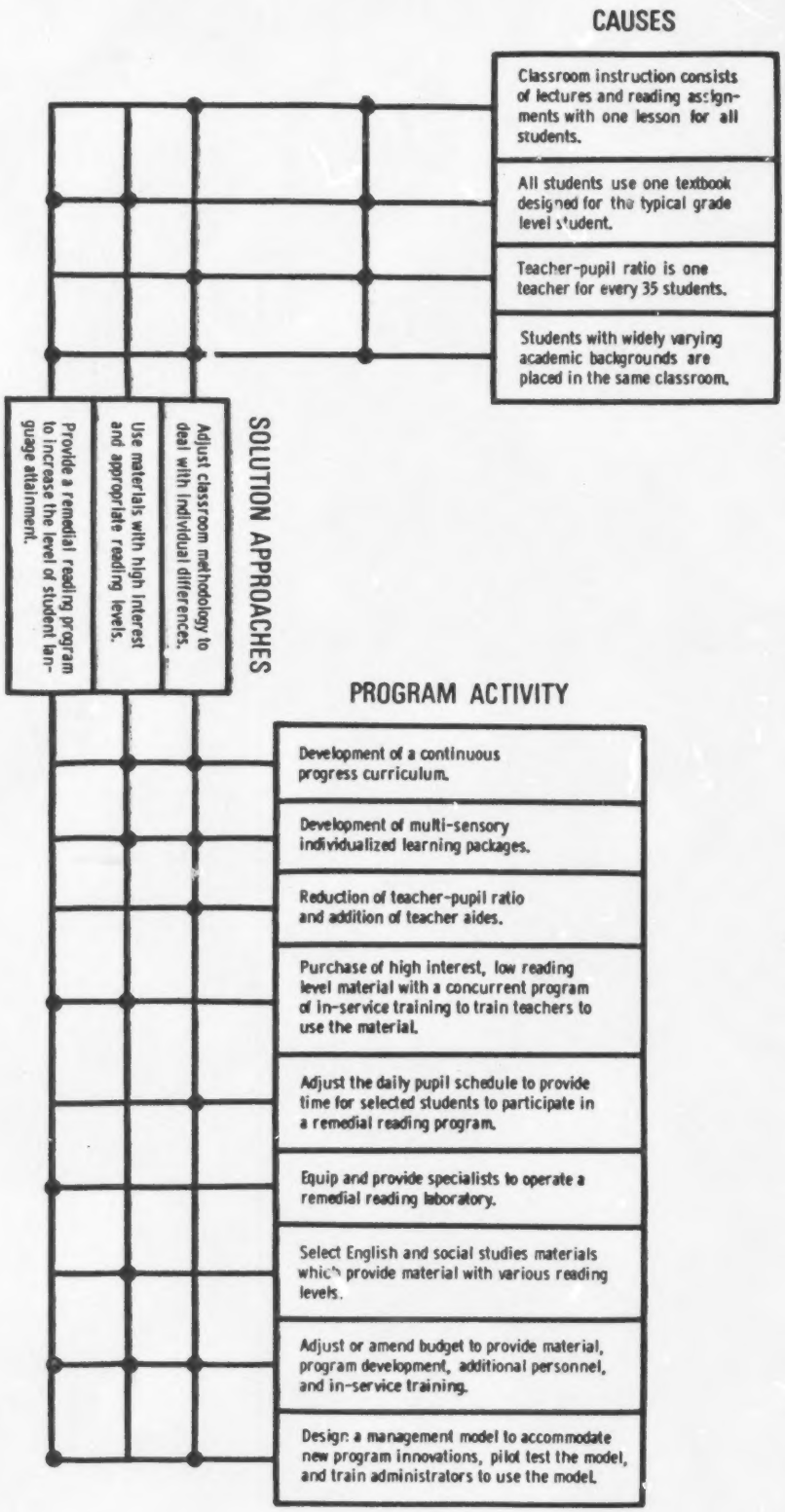
require extensive inservice to acquire the skills and knowledge necessary to implement a solution. Solution approaches inevitably have side effects because they are new activities being introduced into a structured, on-going system.

The complete decision technology should be employed to improve the possibility of maintaining program continuity. Gauging essential program inputs and estimating the impact of solution approaches on the remainder of the system require an appraisal of the entire system. What must be kept in mind is that introducing something new affects the entire structure.

The following program activities, necessary to implement the solution approaches in our example, should be placed in the appropriate boxes.

1. Develop a continuous progress curriculum.
2. Develop multi-sensory, individualized learning packages.
3. Reduce teacher-pupil ratio and add teacher aides.
4. Purchase high interest, low reading level material with a concurrent program of inservice to train teachers to use the material.
5. Adjust the daily pupil schedule to proivde time for selected students to participate in a remedial reading laboratory.
6. Equip and provide specialists to operate a remedial reading laboratory.
7. Select English and social studies materials which provide various reading levels.
8. Adjust or amend the budget to provide materials, program development, additional personnel and inservice.
9. Design a management model to accommodate new innovations, pilot test the model and train administrators to use the model.

Figure IV illustrates the linkage between solution approaches and program activities.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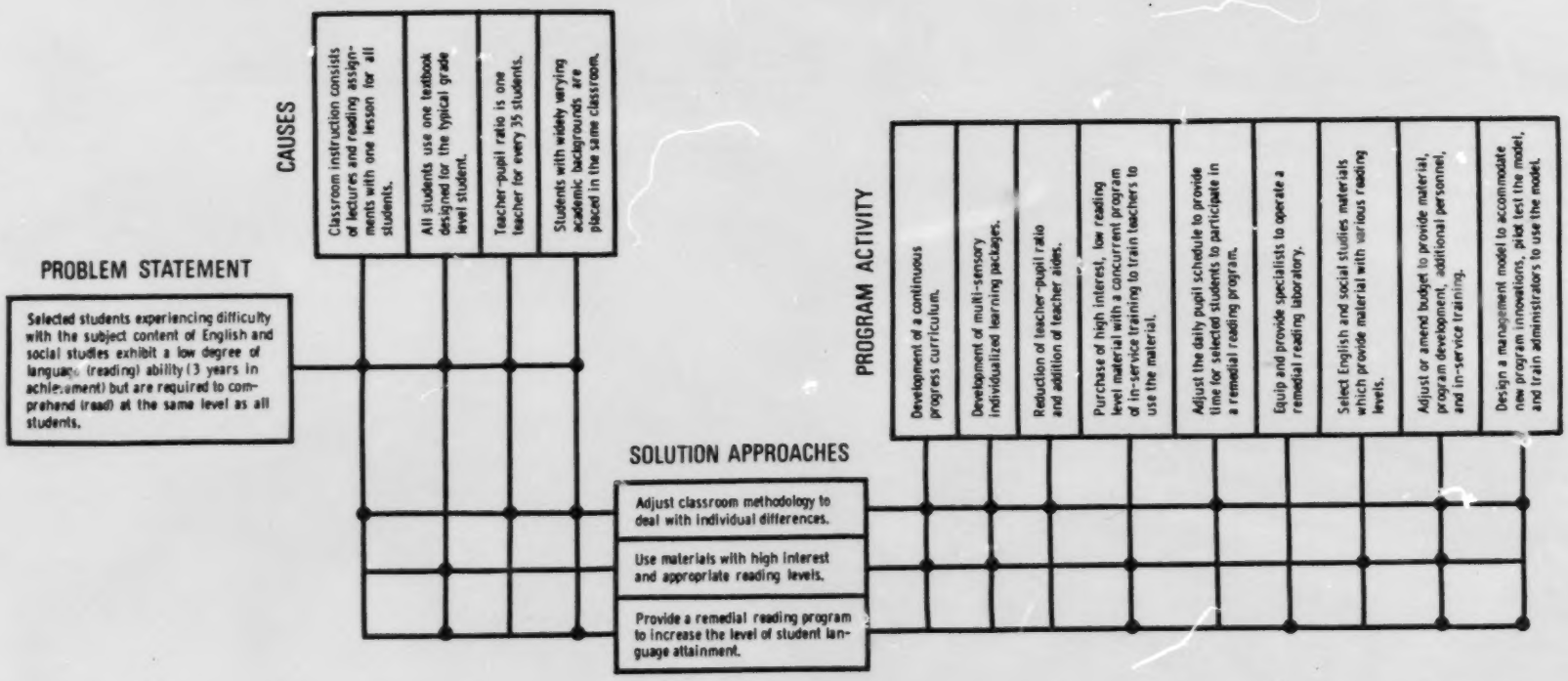
SOLUTION APPROACHES
Adjust classroom methodology to deal with individual differences.
Use materials with high interest and appropriate reading levels.
Provide a remedial reading program to increase the level of student language attainment.
PROGRAM ACTIVITY
Development of a continuous progress curriculum.
Development of multi-sensory individualized learning packages.
Reduction of teacher-pupil ratio and addition of teacher aides.
Purchase of high interest, low reading level material with a concurrent program of in-service training to train teachers to use the material.
Adjust the daily pupil schedule to provide time for selected students to participate in a remedial reading program.
Equip and provide specialists to operate a remedial reading laboratory.
Select English and social studies materials which provide material with various reading levels.
Adjust or amend budget to provide material, program development, additional personnel, and in-service training.
Design a management model to accommodate new program innovations, pilot test the model, and train administrators to use the model.

Figure IV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Equip and provide specialists to operate a remedial reading laboratory.
Select English and social studies materials which provide material with various reading levels.
Adjust or amend budget to provide material, program development, additional personnel, and in-service training.
Design a management model to accommodate new program innovations, pilot test the model, and train administrators to use the model.

COMPLETE CONTINUITY MATRIX

Figure V

Figure V depicts a complete continuity matrix. The matrix provides a visual of connections among the various planning stages most often associated with inservice training. By tracing the dots on the matrix it can be determined where continuity exists among the various components. Implementation of a program activity should reduce a cause or causes thus directly impacting the defined discrepancy.

The proposed meshing of discrepancy analysis and a continuity matrix provides those involved in inservice training a tool for measuring training impact. Within an inservice training program there should be a functional interdependent relationship among problem and causes and solution approaches and between solution approaches and program activities. When this relationship does not exist there is little hope of creating an impact upon defined problems. When continuity does exist between program activity and a problem the possibility of problem reduction is greatly increased.